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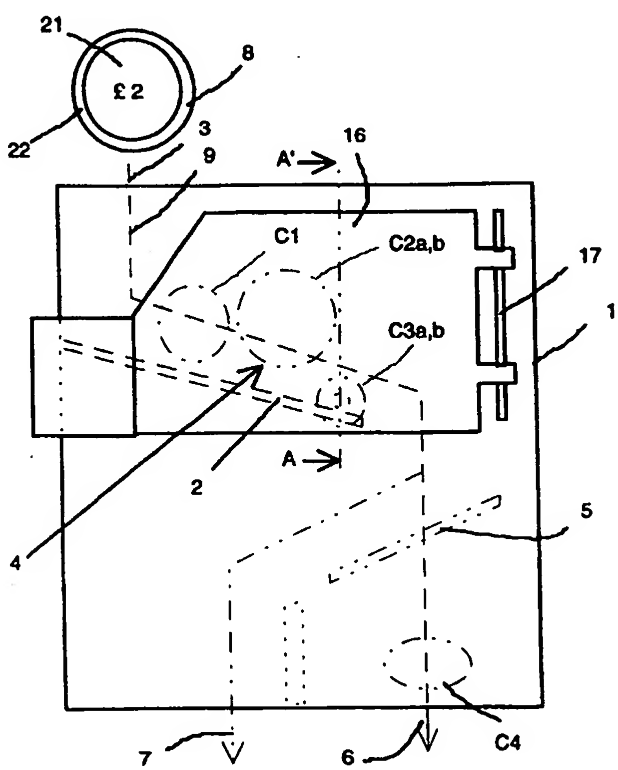
(57) Abstract

A coin acceptor is configured to detect a coin of a given denomination which includes regions that present respective distinctive inductive characteristics, such as a bimetallic coin e.g. the new UK £2.00 coin (8) which has different metallic regions (21, 22). The acceptor has a coin sensing station (4) which includes a sensor coil unit (C3a,b) having a coil face (30) past which the coin (8) passes to form an inductive coupling selectively with substantially only with the outer region (22) of the coin. The area of the coil face (30) is less than 72 mm^2.



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Coin Acceptor

Field of the invention

This invention relates to a coin acceptor and is particularly concerned with an acceptor for coins that include regions of different electrically inductive characteristics, for example bimetallic coins.

Background

Coin acceptors which discriminate between coins of different denominations are well known and one example is described in our GB-A-2 169 429. The acceptor includes a coin rundown path along which coins pass on their peripheral edge surface through a sensing station at which coils perform a series of inductive tests on the coins' major surfaces to develop coin parameter signals that are indicative of the material and metallic content of the coin under test. The coin parameter signals are digitised so as to provide digital coin parameter data, which are then compared with stored coin data by means of a microprocessor to determine the acceptability or otherwise of the tested coin. If the coin is found to be acceptable, the microprocessor operates an accept gate so that the coin is directed to an accept path. Otherwise, the accept gate remains inoperative and the coin is directed to a reject path.

The stored coin data is representative of acceptable values of the coin parameter data. The stored data in theory could be represented by a single digital value but in practice, the coin parameter data varies from coin to coin, due to differences in the coins themselves and consequently, it is usual to store window data corresponding to windows of acceptable values of the coin parameter data. The width of the windows is a compromise between a number of factors. In order to achieve satisfactory discrimination between true and false coins, the window widths should be made as narrow as possible. However, if the windows are made too narrow, there is a risk that true coins will be rejected as a result of minor differences between the characteristics of true coins.

There is an increasing popularity for coins to be minted to include regions of different materials, for example more than one metal or metal alloy, and certain denominations of coins are formed of a central region of a first alloy, which is surrounded by at least one annular region of a second different alloy (referred to hereinafter as a "bimet" coin). The different regions present different inductive characteristics to the sensor coils of the acceptor. The inductive sensors impart eddy currents over an area of the coin that spreads across the different regions of the coin. This causes the conductivity and permeability characteristics of the different metallic regions of the coin to be sensed as a mixed effect, thus clouding the readings provided by the sensor coils. As an example, the new UK bimet £2 coin can give similar readings to some non-bimet coins for conventional sensors.

Another characteristic of bimet coins is that the bond between their first and second regions has a variable electrical characteristic. The electrical connection varies with production, ageing, impact and liquid contamination.

These factors result in the accept windows for coin acceptors employing conventional inductive sensors, having to be made wider than desired for bimet coins and these wide windows allow other coins and objects to be fraudulently accepted as true coins, thus greatly reducing the security and performance of the coin validation process.

It has been proposed in EP-A-0 780 810 to use a coil underlying the coin rundown path, with a face pointing upwardly at the peripheral edge a bimet coin. However, in practice this arrangement is sensitive to the position of the coin in relation to the width of the coin path. The coin can move laterally from side to side in the rundown path, which spuriously alters its inductive coupling with the underlying coil as it moves along the rundown path, leading to unreliable results.

Summary of the invention

With a view to overcoming this problem, the present invention provides a method of detecting a coin of a given denomination having a major surface with inner and outer regions that present respective distinctive inductive characteristics, comprising passing the coin through a coin sensing station which includes a sensor coil unit with a face directed at the major surface of the coin, configured to form an inductive coupling selectively substantially only with the outer region.

Thus, an inductive coupling can be formed between the coil unit and the outer region of the coin selectively, and the coin validity can be tested by determining whether the inductive coupling has predetermined characteristics corresponding to distinctive characteristics for said outer region for a true coin.

It has been found, in accordance with the invention that selective discrimination can be achieved in practice for many coins with regions of different inductive characteristics if the sensor coil unit has a face directed towards the coin to be validated, of an area of less than 72 mm^2.

A further sensor to detect characteristics of the coin may be used in the method according to the invention. The further sensor may comprise a further sensor coil unit so that an inductive coupling may be formed between the further sensor coil unit and the coin. The inductive characteristics of substantially only said inner region of the coin may be selectively detected using the further sensor coil unit.

Alternatively or additionally, the method may include detecting the inductive characteristics of all of said regions of the coin with the further sensor coil unit.

The method according to the invention may be used to validate a bimet coin.

such as a UK £2.00 coin.

The invention also includes method of detecting a coin of a given denomination which includes regions that present respective distinctive inductive characteristics, comprising passing the coin through a coin sensing station which includes first and second sensor coil units each configured to form an inductive coupling selectively with one of said regions, selectively detecting the inductive characteristics of substantially only one of said regions using the first coil unit and selectively detecting the inductive characteristics of substantially only another one of said regions using the second coil unit.

The invention also provides a coin acceptor for detecting a coin of a given denomination having a major surface with inner and outer regions that present respective distinctive inductive characteristics, comprising: a coin path, and a sensor coil unit with a face directed at the major surface of a coin travelling along the path, the coil unit being configured to form an inductive coupling selectively with an outer one of said regions of the coin.

The area defined by the coil windings may generally circular or rectangular in cross section.

The acceptor may include a coin rundown path between sidewalls, with the sensor coil unit being mounted on one of the sidewalls. The sensor coil unit may include two coil assemblies, on opposite sides of the coin rundown path although a single coil may be used.

The acceptor may include a further one or more of the sensor coil units configured to form an inductive coupling selectively with another one more of the regions of the coin. The sensor coil units may be configured in an array.

Brief description of the drawings

In order that the invention may be more fully understood, an embodiment

thereof will now be described by way of example with reference to the accompanying drawings in which:

Figure 1 is a schematic elevational view of a coin acceptor in accordance with the invention;

Figure 2 illustrates schematically the electrical circuits of the acceptor shown in Figure 1;

Figure 3 is a schematic partial cross sectional view of the acceptor taken along the line A - A in Figure 1,

Figure 4 is a schematic view corresponding to Figure 3, for explaining the flux linkage between the coils C3a,b, through the outer annulus of the coin under test,

Figure 5 illustrates the end of the coil C3a which faces the coin under test, and

Figure 6 is a schematic view corresponding to Figure 1, of another embodiment of acceptor in accordance with the invention.

Detailed description

The acceptor shown in Figures 1 to 5 comprises a multi-coin acceptor capable of validating a number of coins of different denominations, including bimet coins, for example the UK coin set including the new bimet £2.00 coin.

The physical layout of the coin acceptor is shown schematically in Figure 1. The acceptor includes a body 1 with a coin rundown path 2 along which coins under test pass edgewise from an inlet 3 through a coin sensing station 4 and then fall towards a gate 5. A test is performed on each coin as it passes through the sensing station 4. If the outcome of the test indicates the presence of a true coin, the gate 5 is opened so that the coin can pass to an accept path 6, but otherwise the gate remains closed and the coin is deflected to a reject path 7. The coin path through the acceptor for a coin 8 is shown schematically by dotted line 9.

The coin sensing station 4 includes three coin sensing coil units C1, C2a,b and

C3a,b shown in dotted outline, which are energised in order to produce an inductive coupling with the coin. Also, a fourth coil unit C4 is provided in the accept path 6, downstream of the gate 5, in order to detect whether a coin that was determined to be acceptable, has in fact passed into the accept path 6.

The coils are of different geometrical configurations and are energised at different frequencies by a drive and interface circuit 10 shown in Figure 2. Eddy currents are induced in the coin under test by the coil units. The different inductive couplings between the three coils and the coin characterise the coin substantially uniquely. The drive and interface circuit 10 produces three corresponding coin parameter data signals x_1, x_2, x_3 as a function of the different inductive couplings between the coin and the coil units C1, C2, C3. A corresponding signal x_4 is produced for the coil unit C4. The coin parameter data signals x_1, x_2, x_3 and x_4 can be formed in a number of different known ways. One way is described in detail in our GB-A-2 169 429 in which the coils are included in individual resonant circuits that are maintained at their natural resonant frequency as the coin passes the coil. This frequency deviates on a transitory basis as a result of the momentary change in impedance of the coil produced by the inductive coupling with the coin. This change in impedance produces a deviation both in amplitude and frequency. As described in our prior specification, the peak amplitude is monitored and digitised in order to provide the coin parameter signal x for each coil. By maintaining the drive frequency for the coil at its natural resonant frequency during passage of the coin past the coil, the amplitude deviation is emphasised so as to aid in discrimination between coins. However, the coin parameter signals x can be formed in other ways, for example by monitoring the frequency deviation produced as the coin passes the coil and reference is directed to GB 1 452 740.

In order to determine coin authenticity, the three parameter signals x_1, x_2, x_3 produced by a coin under test are fed to a microcontroller 11 which is coupled to a memory in the form of an EEPROM 12. The microcontroller

11 compares the coin parameter signals derived from the coin under test with corresponding stored values held in the EEPROM 12. The stored values are stored in terms of windows having upper and lower limits. Thus, if the individual coin parameter signals x_1, x_2 and x_3 fall within the corresponding windows associated with a true coin of a particular denomination, the coin is indicated to be acceptable, but otherwise is rejected. If acceptable, a signal is provided on line 13 to a drive circuit 14 which operates the gate 5 shown in Figure 1 so as to allow the coin to pass to the accept path 6. Otherwise, the gate 5 is not opened and the coin passes to reject path 7.

The microcontroller compares the coin parameter data signals x_1, x_2 and x_3 with a number of different sets of operating window data appropriate for coins of different denominations so that the coin acceptor can accept or reject more than one coin of a particular currency set. If the coin is accepted, its passage along the accept path 6 is detected by coil unit C4, and the unit 10 passes corresponding data x_4 to the microprocessor 11, which in turn provides an output on line 15 that indicates the amount of monetary credit attributed to the accepted coin.

The configuration of the sensor coils will now be described in more detail. Referring again to Figure 1, the acceptor has a coin door 16 which is hinged on a shaft 17 on the acceptor body 1, in a conventional manner. The coin run-down path 2 is provided between an interior wall 18 of the door 16 and a wall 19 of the acceptor body 1, as shown in more detail in Figure 3. The run-down path 2 comprises an inclined lip 20 on the door 16, down which the coin runs edgewise past the sensor coil units C1, C2 and C3. The coin 8 is shown on the lip 20 of the run-down path 2 in Figure 3. As known in the art, the door 16 is spring biased to the closed position shown in Figures 1 and 3 but can be hinged outwardly from the body 1 in the event of a coin jam so as to release the jammed coin and allow it to fall to the reject path 7.

Referring again to Figure 1, the coil unit C1 comprises a coil mounted on the

inside of the wall 19 of the housing 1 and comprises a single coil wound on a circular bobbin not shown, which is of a relatively large area compared with the area of the major face of the coins of different denominations that can be validated by the acceptor. Typically, the coil unit C1 has an outer diameter of 14 mm and hence an area of 154 mm^2. As the coin 8 passes the coil unit C1, the inductive coupling between the coil and the coin is momentarily altered, to produce the coin parameter signal x_1 as previously described. The relatively large area of the coil C1 results in the signal being an average of the inductive characteristics of substantially all of the major face of the coin under test.

The coil unit C2 comprises a pair of coils C2a, C2b, electrically connected in series, that are respectively wound on identical rectangular bobbins, not shown. One of the coil units C2a is mounted on the inside of wall 19 of the acceptor housing 1 and the other coil unit C2b is mounted on the wall 18 of the door 16, opposite the coil C2a. Thus, as the coin 8 passes between the coils C2a, C2b, the inductive coupling between the coils is interrupted, resulting in the generation of the coin parameter signal x_2 in the manner previously described. The area of the coils C2a, C2b, is relatively large in comparison with the area of the coins of different denominations that can be validated by means of the acceptor, which results in the signal being an average of the inductive characteristics of substantially all of the major face of the coin under test. As an example, the area of the face of each coil C2a,b is 20 mm, giving an area of 315 mm^2.

As shown in Figure 1, the coin 8 to be validated comprises a bimet coin and in this example comprises the new £2.00 coin. The coin 8 is discoidal with opposed major surfaces 8a, 8a' and a cylindrical, peripheral edge surface 8b. The coin is made up of a first, inner central cupro-nickel core region 21 surrounded by a second, outer, circular region or ring 22 of an alloy referred to herein as bronze, comprising 76% Cu, 4% Ni and 20% Zn. These two regions present different inductive characteristics to the sensor coil units,

which are thus averaged by the coil units C1 and C2a,b. Also, as previously explained, the join between the regions 21, 22 may have different electrical characteristics from coin to coin, which will affect the values of the signals x_1, x_2 produced by the coil units C1, C2. As a result, the coil units C1 and C2a,b do not in themselves necessarily provide coin parameter signals for discriminating satisfactorily between the £2.00 coin and other denominations and frauds; this problem is however, overcome, in accordance with the invention, by the provision of the coil unit C3a,b.

Referring to Figure 3, the coil unit C3a,b comprises a pair of coil assemblies C3a, C3b mounted on the inside of the wall 19 of the acceptor body 1 and on the wall 18 of the door 16. The coil assemblies C3a, C3b are configured to form an inductive coupling selectively with the bronze ring 22 of the bimet coin 8 under test i.e. with no significant inductive coupling to the central cupro-nickel region 21 of the coin.

Each of the coil assemblies C3a,b comprises a generally cylindrical bobbin 23 of plastics material, on which windings of a coil 24 are formed. The bobbin 23 is push-fitted into a so-called half pot core 25 made of sintered ferrite material. The core 25 includes a central, cylindrical yoke 26 formed with a through hole to reduce the amount of ferrite material used, and a surrounding, concentric, cylindrical support flange 27.

As an alternative to using a bobbin, the windings of the coil 24 may be wound around a former, not shown, and the windings heated to melt their insulation, so that on cooling, a self suppporting coil is formed, which is then push-fitted into the half pot core 25.

The support flange 27 of the half pot core 25 is push-fitted in a corresponding recess in the wall; thus the flange 27 of assembly C3a is push fitted into a cylindrical recess 28 in wall 19 and the flange 27 of assembly C3b is push fitted into a corresponding recess 29 in the wall 18. The outer diameter d_1 of

the windings of the coil 24 is 7.3 mm. . The inner diameter d_2 of the coil 24 with its bobbin 23 is 2.78 mm and the diameter of the hole through the yoke 26 is 2mm. The faces 30 of the coil assemblies C3a,b in this example, are spaced apart by 6.24 mm. The coils 24 have an axial length of 2.78 mm. The outer diameter d_3 of the half pot cores 25 is 9 mm and thus the area A of the end face 30 of each coil unit i.e. the end which faces the coin under test, is in this example 63.62 mm^2. The windings 24 of the assemblies C3a,b are electrically connected in series. As can be seen in Figure 3, the coil assemblies C3a,b are arranged with the coils 24 arranged on a common axis B, on opposite sides of the coin 8 under test. The common axis B thus extends transversely of the major surfaces 8a, 8a' of the coin under test as it passes between the coils, and the main faces 30 of the coils 24 faces the major surfaces 8a, 8a' of the coin.

As well known in the art of solenoid coil design, the magnetic field of a generally cylindrical coil is concentrated along the coil axis; thus, for each of the coil assemblies C3a,b, the field is concentrated mainly in the ferrite yoke 26 of the half pot core 25 and the flux around the coil is mainly channelled in a loop around the coil by the surrounding ferrite flange 27, except in the region of face 30 where the flux passes through the surrounding material back to the yoke 26. Accordingly, the sensitivity of the assemblies C3a,b to passing coins is for the most part, restricted to the region of the coin which passes between the yokes 26. As shown in Figure 3, the assemblies C3a,b are positioned closely adjacent the coin rundown path 2 and the dimension d_3 of the coils is such that the inductive coupling between the coin and the coils is restricted substantially only to the second, outer region 22 of the coin 8, with no significant coupling occurring with the first inner region 21. This can be seen more clearly from Figure 4, which illustrates schematically the relative dimensions and configuration of the coil assemblies C3a,b and the coin 8 when it passes through the gap between the coils. As can be seen from Figure 3, the half pot cores 25 extend below the coin rundown path 20 in order that the cores 26 be configured in alignment with the outer ring 22 of the coin 8.

The coin parameter signal x_3 produced when the coin 8 passes through the coil unit C3, is thus determined primarily by the characteristics of the bronze region 22 of the £2.00 coin, and not to any major extent by the characteristics of the cupro-nickel region 21 or the join between the regions 21, 22. Thus, the coin parameter signal x_3, in combination with the signals x_1 and x_2, provide a set of coin parameter signals that substantially uniquely characterise each of the coins of the UK coin set, including the £2.00 coin.

The readings from the coil assemblies C3a,b have been found in practice to be highly stable, which may be due to the coils being directed selectively to a region of the coin which is relatively free of surface irregularities.

It will be appreciated that the described example of the invention is not restricted to detecting the UK £2.00 coin in the UK coin set and is applicable generally to detecting bimet coins, which occur in the coin sets of other countries and also bimet tokens. The coin data stored in the EEPROM 12 can store appropriate window data for the coins or tokens concerned. Generally, it has been found in accordance with the invention that improved discrimination can be achieved by making the area *A* of the coil unit which faces the coin, such as the coil C3a,b, smaller than 72 mm^2, which permits coin regions with individual inductive characteristics to be sensed.

Many modifications and variations fall within the scope of the invention. For example, although the coil unit C3 comprises an opposed pair of coils C3a,b in the embodiment of Figures 1 to 5, a single coil may be used.

The or each coil C3 need not be circular. In fact, advantages can be obtained from square or rectangular wound coils.

Also, different configurations of the coil units C1 and C2 can be used depending on the currency to be validated. Thus, the coil unit C1 or C2 or both of them may be located at a different location relative to the coin

rundown path 2 as compared with Figure 1. Furthermore, at least one optical coin sensor (not shown) may be included on the rundown path 2 in addition to the coil units C1, 2 or as a replacement for one of them.

In a modification, the door 16 and the wall 19 of the housing 1 may be provided with a series of recesses 28, 29 for the coil assemblies C3a,b to allow them to be mounted at different positions, in order to maximise performance for different currency sets. Alternatively, an incremental adjustment mechanism may be provided to allow adjustment of the positions of the coil assemblies C3a,b.

The coil assemblies C3a,b need not only be used to detect the outer region 22 of the coin. Figure 6 illustrates a modification in which the coil unit C2 is replaced by a coil unit C5 which includes series connected coil assemblies C5a,b corresponding to the assemblies C3a,b. The coil unit C5 is configured to detect selectively the inductive characteristics of the first, inner region 21 of the bimet coin 8. As the coin rolls down the path 2, the output x_1 from the coil C1 allows the microprocessor 11 reaches a maximum value whilst the inner region 21 of the coin passes between the coil assemblies C5a,b which allows the coupling with inner region 21 to be monitored selectively. Its coil faces are sufficiently small in area to allow sensing of the region 21 selectively. The coin parameter signal x_2 during the time window is thus representative of the inductive characteristics of the region 21 and is not substantially influenced by the region 22 or the join between it and the region 21.

The coil assemblies C3a,b and C5a,b need not necessarily be connected in series as previously described but have switched connections to perform different inductive tests, as described in our EP-A-0 599 844.

Also, the coil assemblies C3a,b and/or C5a,b need not necessarily be disposed along the lip 20 but could be disposed at other locations within the acceptor. A plurality of the coil assemblies could be disposed in an array.

Whilst in the foregoing embodiments, detection of a UK £2 bimet coin has been described, the acceptor can also be used to detect bimet coins of different currencies such as the Euro. It will also be understood that the regions of the coin with distinctive characteristics may be configured differently. For example, the coin may include more than one ring of different metallic composition. Also, the different regions need not necessarily be rings but could be of other shapes. Not all of them need be metallic. They may comprise the absence of coin material such as a hole.

Furthermore, the regions may be different regions of a coin made of a uniform metallic composition, for example a US 25 cent coin, which has a highly undulating surface in its central region but is smoother in the region of its rim. These different regions present different inductive characteristics, which can be detected individually in accordance with the invention.

Generally, it will be appreciated that further coil assemblies corresponding to assemblies C3a,b can be included at positions to detect preselected regions of the coin under test in order to detect their inductive characteristics substantially uniquely.

As used herein, the term "coin" includes coins, tokens and other coin-like items.

Claims

1. A method of detecting a coin of a given denomination having a major surface with inner and outer regions that present respective distinctive inductive characteristics, comprising passing the coin through a coin sensing station which includes a sensor coil unit with a face directed at the major surface of the coin, configured to form an inductive coupling selectively substantially only with the outer region.

2. A method according to claim 1 including forming the inductive coupling between the coil unit and the outer region of the coin, and determining whether the inductive coupling has predetermined characteristics corresponding to said distinctive characteristics for the outer region.

3. A method according to claim 1 or 2 wherein the face of the sensor coil unit directed towards the coin to be validated, has an area of less than 72 mm^2.

4. A method according to claim 1, 2 or 3 including using a further sensor to detect characteristics of the coin.

5. A method according to claim 4 wherein the further sensor comprises a further sensor coil unit, and the method includes forming an inductive coupling between the further sensor coil unit and the coin.

6. A method according to claim 5 including selectively detecting the inductive characteristics of substantially only said inner region of the coin using the further sensor coil unit.

7. A method according to claim 5 including detecting the inductive characteristics of all of said regions of the coin with the further sensor coil

unit.

8. A method of detecting a coin of a given denomination which includes regions that present respective distinctive inductive characteristics, comprising passing the coin through a coin sensing station which includes first and second sensor coil units each configured to form an inductive coupling selectively with one of said regions, selectively detecting the inductive characteristics of substantially only one of said regions using the first coil unit and selectively detecting the inductive characteristics of substantially only another one of said regions using the second coil unit.

9. A method according to any preceding claim, used to validate a bimet coin.

10. A method according to any preceding claim used to validate a UK £2.00 coin.

11. A coin acceptor for detecting a coin of a given denomination having a major surface with inner and outer regions that present respective distinctive inductive characteristics, comprising:

a coin path; and

a sensor coil unit with a face directed at the major surface of a coin travelling along the path, the coil unit being configured to form an inductive coupling selectively with an outer one of said regions of the coin.

12. A coin acceptor according to claim 11 wherein the face of the sensor coil unit directed towards the coin to be validated, has an area of less than 72 mm^2.

13. A coin acceptor according to claim 11 or 12 wherein the sensor coil unit includes coil windings on a bobbin fitted on a yoke.

14. A coin acceptor according to claim 13 wherein the yoke comprises a sintered ferrite material.

15. A coin acceptor according to any one of claims 11 to 14 wherein the area defined by the coil windings is generally circular in cross section.

16. A coin acceptor according to any one of claims 11 to 14 wherein the area defined by the coil windings is generally rectangular in cross section.

17. A coin acceptor according to any one of claims 11 to 16 wherein the path comprises a coin rundown path between sidewalls, and the sensor coil unit is mounted on one of the sidewalls.

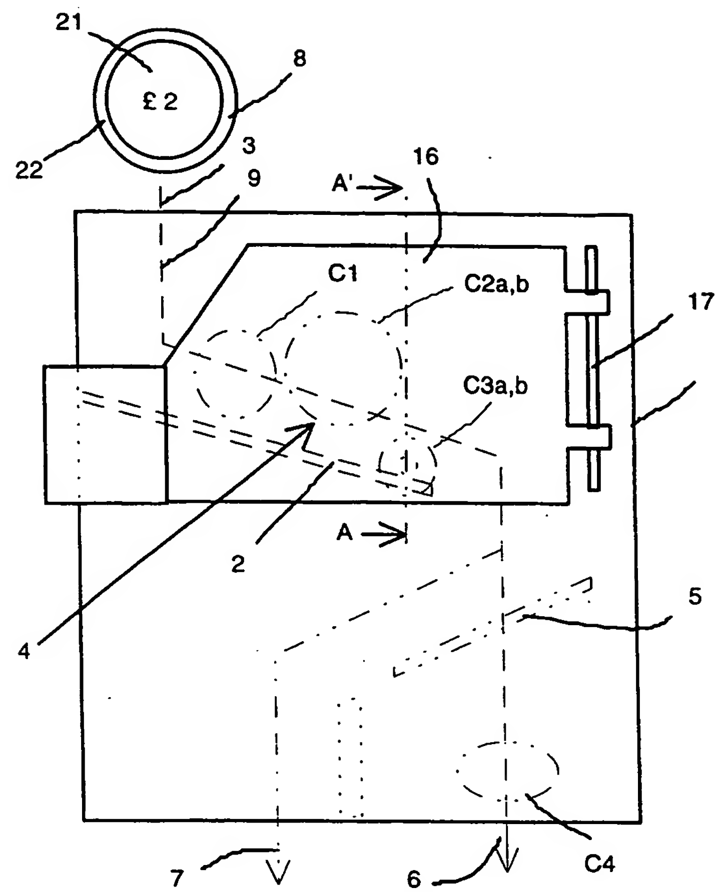
18. A coin acceptor according to claim 17 wherein the sensor coil unit includes two coil assemblies, on opposite sides of the coin rundown path.

19. A coin acceptor according to any one of claims 11 to 17 wherein the coil unit includes a coil with a longitudinal axis which extends transversely of the major surface of the coin as it passes the coil.

20. A coin acceptor according to any one of claims 11 to 18 including a further one of said sensor coil units configured to form an inductive coupling selectively with said inner region of the coin.

21. A coin acceptor according to any one of claims 11 to 19 including an array of said sensor coil units configured to form an inductive coupling selectively with respective regions of the coin.

22. A coin acceptor according to any one of claims 11 to 20 including at least one further sensor configured to detect characteristics collectively of the inner and outer regions of the coin.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C3a,b
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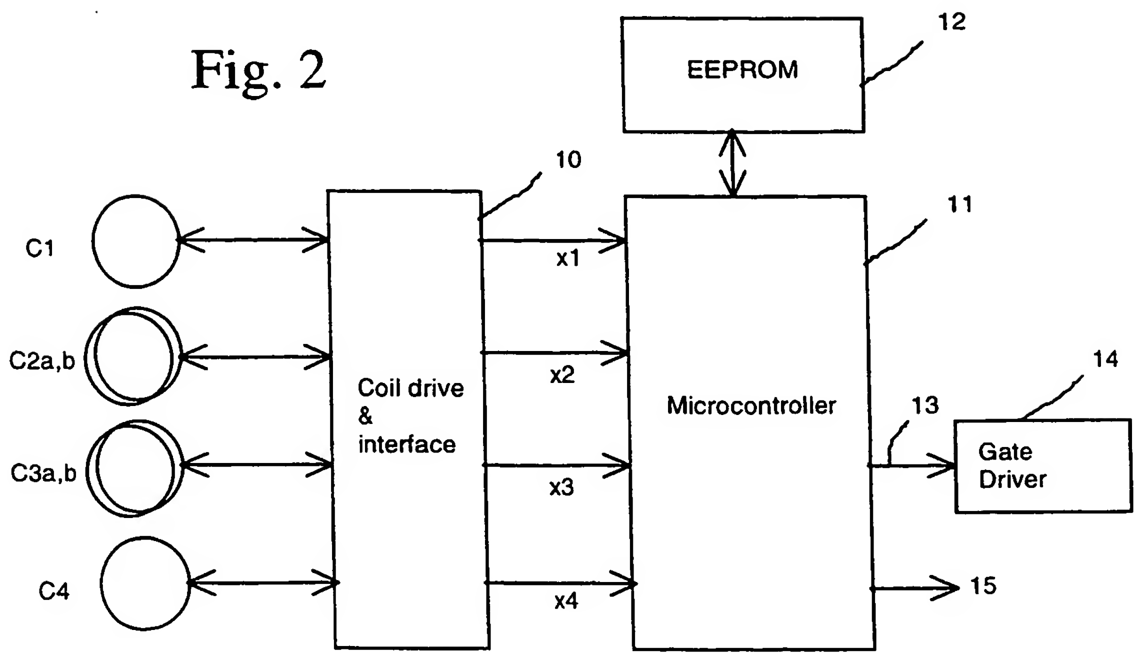
Fig. 1

Fig. 2


EEPROM
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C1
C2a,b
C3a,b
C4
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interface
x1
x2
x3
x4
Microcontroller
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14
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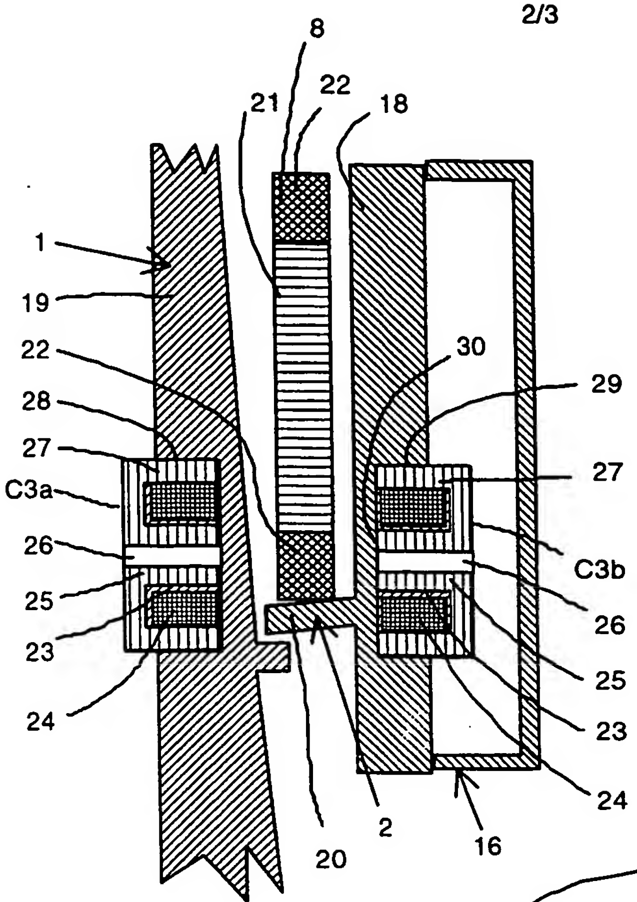
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C3b
26
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2
16

Fig. 3

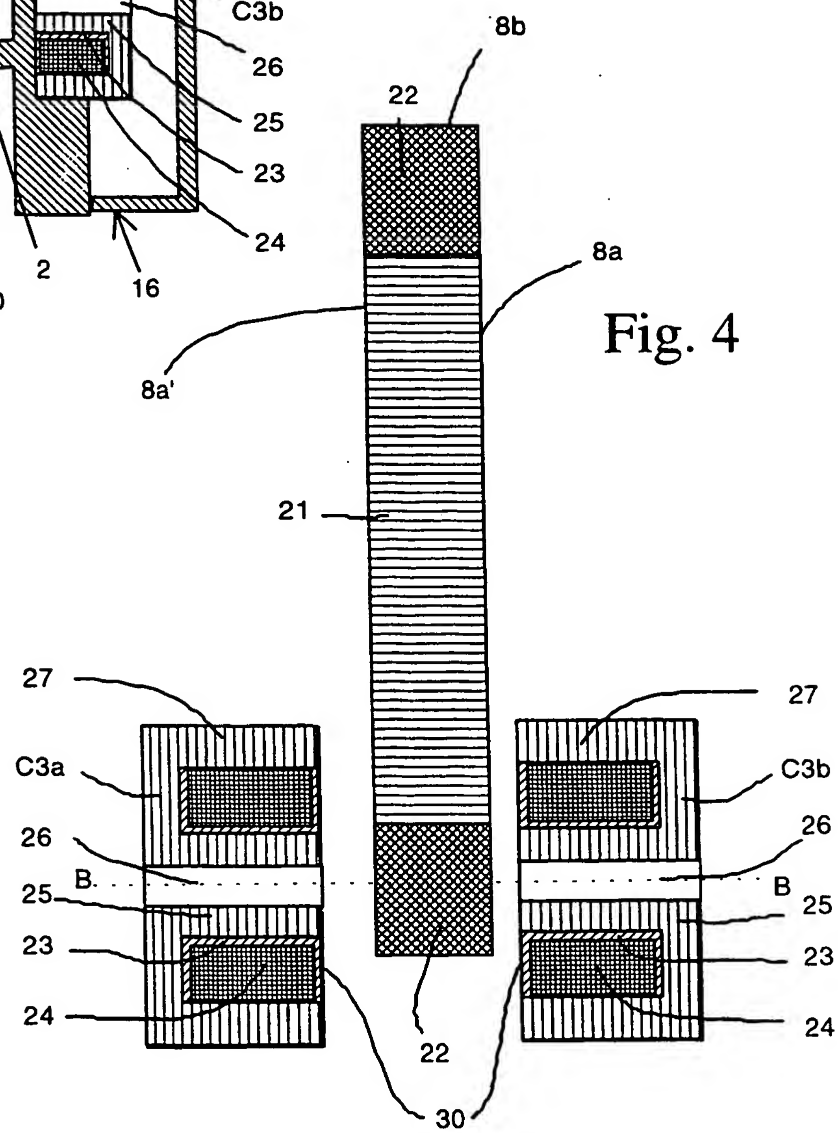

8b
22
8a
8a'
21
27
C3a
26
B
25
23
24
22
30
27
C3b
26
B
25
23
24

Fig. 4

Fig. 5

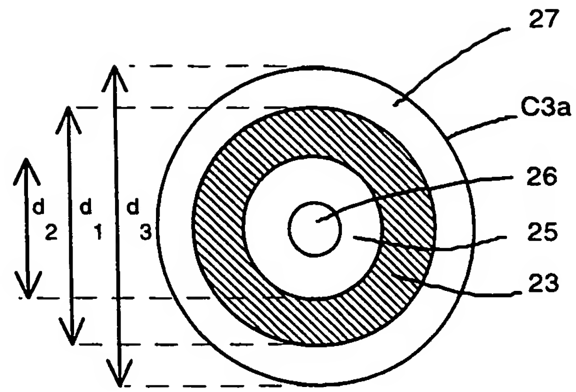
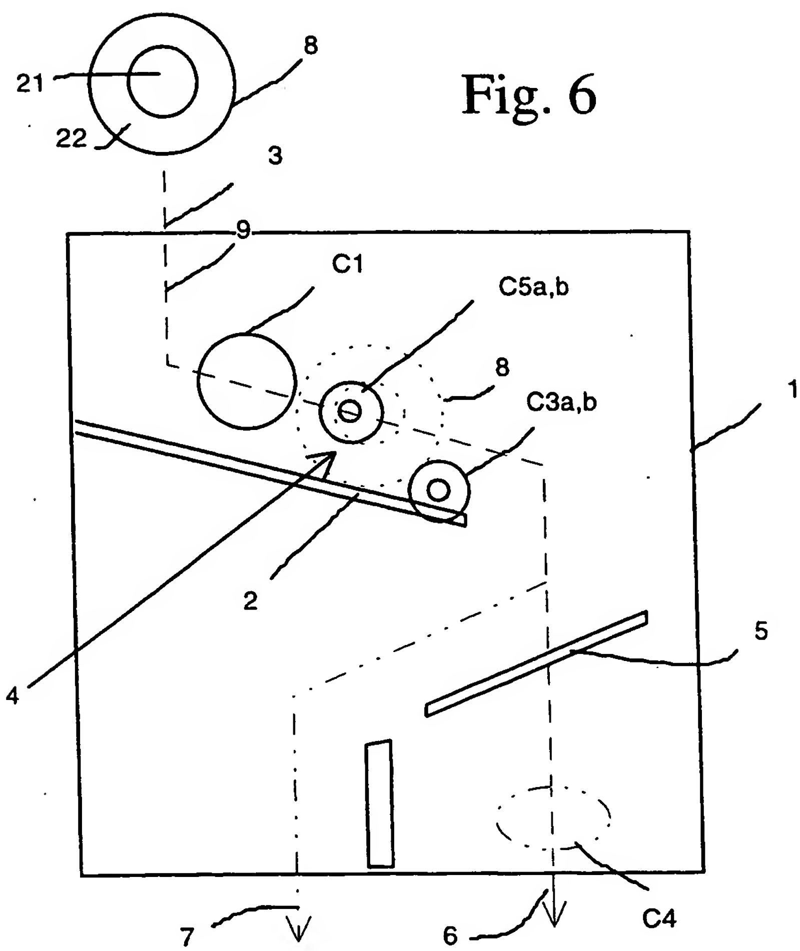


Fig. 6



INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 98/03230

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 G07F3/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 G07F G07D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 710 933 A (COIN ACCEPTORS INC) 8 May 1996 see abstract see column 1, line 22 - line 46 see column 3, line 4 - line 28 see column 4, line 36 - column 5, line 42 see figures 1-3,4D ---	1,2,9, 11,13, 15, 17-19,21
P,A	EP 0 862 147 A (NAT REJECTORS GMBH) 2 September 1998 see abstract see column 5, line 13 - line 22 see column 2, line 19 - line 51 see column 3, line 45 - column 4, line 6 see column 5, line 13 - line 22 see figures 1-3 --- -/--	1-5,8,9, 15,17,18

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
11 January 1999	19/01/1999

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Bocage, S

2

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INTERNATIONAL SEARCH REPORT

International Application No
PCT/GB 98/03230

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 780 810 A (NAT REJECTORS GMBH) 25 June 1997 cited in the application see abstract see column 2, line 30 - line 57 see column 3, line 53 - column 5, line 29 see figures 1,3	1-6,8,9, 11,12, 15,17,20
A	EP 0 724 237 A (ASAHI SEIKO CO LTD) 31 July 1996 see abstract see column 2, line 27 - column 4, line 6 see figures 1,2,8	5,13,15, 16,18,19

2

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/GB 98/03230

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0710933 A	08-05-1996	US 5662205 A	02-09-1997
		BR 9505060 A	14-10-1997
		CA 2160623 A	04-05-1996
		CN 1129831 A	28-08-1996
		JP 8278288 A	22-10-1996
EP 0862147 A	02-09-1998	DE 19702986 A	30-07-1998
EP 0780810 A	25-06-1997	DE 19548233 A	26-06-1997
EP 0724237 A	31-07-1996	JP 8202917 A	09-08-1996
		CN 1134001 A	23-10-1996